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Abstract

SOME ASPECTS OF RADIOACTIVE WASTE DISPOSAL IN CZECHOSLOVAKIA AS A DENSELY POPULATED CONTINENTAL COUNTRY

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The problems of decontamination and waste disposal are being investigated, in the Institute of Nuclear Research, both on laboratory and plant scale. In the field of the investigation of natural sorbents the following rocks seem to satisfy best the criteria for the selection of suitable column materials: zeolitically changed pumice ryolite as well as basalt and tefrite tuffs for Cs sorption, the best results for Sr sorption under certain conditions were shown by ryodacite tuff.

Since the degree of toxicity of radioactive waters is given by biologically hazardous radionuclides, especially Sr^{90}, ground disposal of radioactive waters containing Sr^{90} in concentrations exceeding by several orders the MPC values cannot be realized in densely populated countries. The maximum possibility of extraction of such a radionuclide seems to be provided by a substance capable of retaining Sr^{+} with highest selectivity, i.e. in a medium of Ca^{2+} hardness. The results of this investigation justify the opinion that the application of synthetized sorbents will lead to a marked progress in the decontamination of low- and medium-level wastes.

In the field of decontamination of waters containing anionic radioactivities, hydrated oxides showed high capacities and higher K_d values for S^{35} and P^{32} sorption than ionic precipitates.

Another developed method is based on the principle of an electrolytical dissolution of Al or Fe electrodes, when in the presence of phosphate ions in the solution flakes of Al or Fe phosphates are formed. This results in an effective separation of alkaline earth elements, radiocolloids and colloids from the solution. The device proposed the use of two stages,

primary classical chemical precipitation in an excess of phosphate, and sorption on a precipitate of aluminium and iron phosphate formed by anodic dissolution.

In an advanced stage of development is a complex method of a counter-current sorption on sorbent on suspension, which is governed by laws of extraction and is effective for the separation of not only ions but also radiocolloids. The technological apparatus consists of 3 stages. As the final decontamination stage, columns filled with a cheap natural sorbent are being developed.

In the study of insolubilisation of radioisotopes, great attention has been paid to the behaviour of the solid phase in the thermal treatment of melted rocks. In the investigation of the diffusion of Sr and Cs in melted basalt, changes of the activation energy of diffusion with temperature have been observed. Above the recrystallisation point, a sudden increase of the activation energy takes place, which confirms the hypothesis on the relative immobilization of fixed ions in the recrystallized phase.

In order to enable the operation of the Institute, two decontamination units of radioactive wastes have been built. The first unit is equipped with two types of evaporators, one for a capacity of 200 l/hr and the other for 130 l/hr. The first evaporator is a classical boiler type and the second one a film type, both with duplicator heating.

For the full operation of the Institute, especially of the radiochemical laboratories, a large unit of an output of several m^3/hr has been built. The unit is equipped with a classical decontamination device. The major part of waste waters is treated by chemical precipitation. For wastes with higher radioactivities, an evaporator of an output of $2m^3$/hr is installed in the unit. The sludge from the chemical precipitation is filtered by means of a rotation filter and fixed into cement. The volume of solid wastes is reduced by pressing.

In view of the unfavourable geological conditions of the territory of CSSR for direct ground disposal, the technological practice is directed to old underground spaces selected by suitable geological and hydrogeological conditions.